

Tuning conditions between quantum dots and photonic crystals

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The possibility of developing a single photon source with a controlled emission directionality and enhanced emission rate by using quantum dots (QDs) coupled to a high Q photonic crystal (PC) opens important technological applications e.g. single photon emitters and detectors. Hence, understanding and controlling this coupling is essential if the weak or strong coupling regime is to be routinely achieved. Coupling conditions are however, very demanding, since both the position of the QD and its frequency must be tuned to the PC mode location and the ultra sharp resonant frequency.

We will demonstrate using the InAs/GaAs system a strategy which allows for the deterministic coupling of a single QD to an S1 PC. This technique is general and can be applied to other PC types [1]. We report high Purcell factors and non-trivial relaxation dynamics for off resonance lines in all fabricated structures. We will discuss the coupling of an L3 PC with a dilute InAs/GaAs QD system which shows an ultra low threshold stimulated emission. This threshold-less laser is realized even for off -resonance coupling conditions between a few QDs and the L3-PC.

This new body of experimental observations suggests a relaxation of the coupling conditions which is specific to the QDs. We will present evidence that the continuum of states associated with the wetting layer is involved in these relaxed coupling conditions.

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[1] A. Badolato et al., *Science* (in press 2005).